STRATEGIES OF YEAST MANIPULATION TO PRODUCE WINE WITH REDUCED LEVELS OF ETHANOL

OBJECTIVES:

1. **To identify** the **factors** that have motivated this research.
2. **To understand** the **carbohydrate metabolism** of the yeast ***Saccharomyces cerevisiae.***
3. **To know** the different **strategies** which involve ***S. cerevisiae*** and their respective benefits and disadvantages.
4. **To know** the strategy of **mixed fermentation** and it's differences depending on the inoculation

CAUSES:

- GLOBAL WARMING: average temperature ↑
- LATE HARVESTING

CONSEQUENCES:

- Stuck and sluggish fermentations
- Poor development during wine aging
- Loss of competitiveness → taxes
- Altered sensorial perception

GRAPES WITH ↑ [SUGARS] → **WINES WITH ↑ [ETHANOL]**

STARTEGY OF GENETIC ENGINEERING → Glycerol overproduction

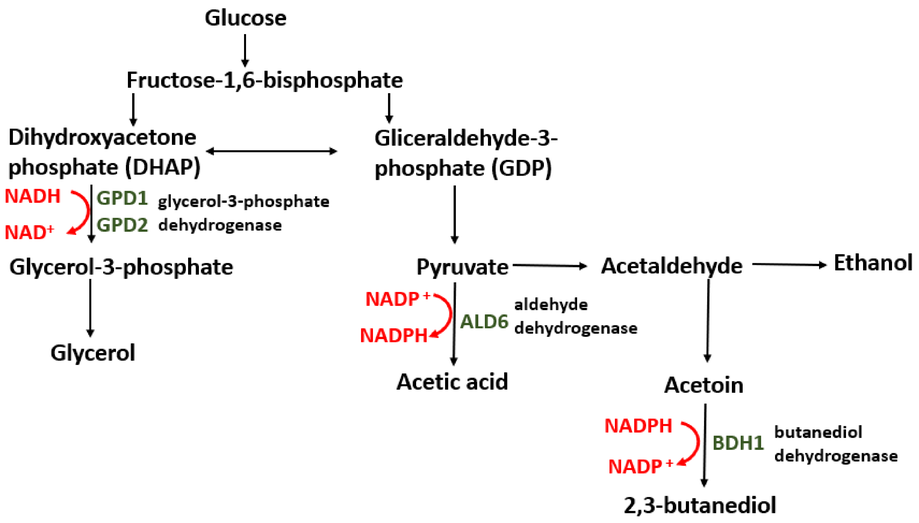

Figure 1. Genetic modifications of *S. cerevisiae* to decrease ethanol yield and produce glycerol.

STRATEGY OF EVOLUTIONARY ENGINEERING

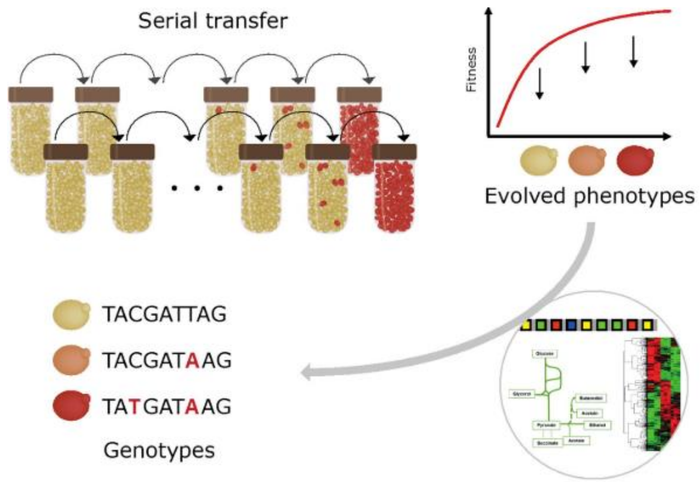

Figure 2. Evolutionary strategy by serial batch cultivation.(Tilloy et al. 2015)

STRATEGY OF MIXED FERMENTATION:

- Simultaneous inoculation: 1 inoculation

Mixed culture: Non-*Saccharomyces*/ *Saccharomyces*

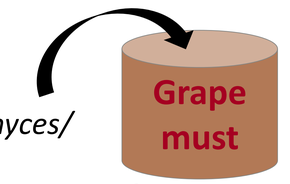

Figure 3.

- Sequential inoculation: 2 inoculations

Non-Saccharomyces culture

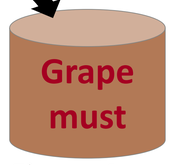

Figure 4. First inoculation

Saccharomyces culture

Figure 5. Second inoculation

CONCLUSIONS:

1. **Global warming** is the **main factor** directly related to the **increase content of ethanol in wines**.
2. **Crabtree effect** is the trait that makes ***S. cerevisiae*** the **most appropriate** yeast for **sugar fermentation**.
3. **Genetic engineering** of *S. cerevisiae* shows **effective results** decreasing ethanol yield but **GMOs are not accepted** by consumers. **Evolutionary engineering** of *S. cerevisiae* is the **alternative** to genetic engineering but it takes a **long time to obtain evolved yeast strains.**
4. **Mixed fermentation with sequential inoculation** is the most promising strategy to **reduce ethanol** content and give rise to wines with **new sensory properties.**

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